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First records of the diving beetles *Hydrovatus subrotundatus* Motschulsky, 1859 and *Hydrovatus pudicus* (Clark, 1863) in Taiwan (Coleoptera, Dytiscidae, Hydroporinae, Hydrovatini)

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Abstract

We provide the first records of the diving beetles *Hydrovatus subrotundatus* Motschulsky, 1859 and *Hydrovatus pudicus* (Clark, 1863) from Taiwan. They are otherwise widespread in Southeast Asia. The habitats of both species and the associated diving beetle fauna are briefly described. Altogether eight species of the genus *Hydrovatus* are now recorded from Taiwan, raising the number of Taiwanese dytiscid species to 68.

Keywords

Aquatic Coleoptera, *Hydrovatus*, Taiwan fauna, new records

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Introduction

Dytiscidae, the diving beetles, is the most diverse group of aquatic Coleoptera, with more than 4,500 species (Nilsson and Hájek 2021). *Hydrovatus* Motschulsky, 1853, a megadiverse lentic diving beetle genus (Biström 1997; Biström and Bergsten 2016; Watanabe and Biström 2020), belongs to the tribe Hydrovatini of the subfamily Hydroporinae. It is cosmopolitan except absent in Antarctica and consists of 214 species (Nilsson and Hájek 2021). To date, six species of *Hydrovatus* have been recorded in Taiwan: *H. acuminatus* Motschulsky, 1859, *H. bonvouloiri* Sharp, 1882, *H. remotus* Biström & Watanabe, 2017, *H. seminarius* Motschulsky, 1860, *H. stridulus* Biström, 1997, and *H. subtilis* Sharp, 1882 (Nilsson et al. 1995; Biström 1997; Watanabe et al. 2018).

An annotated list of the Dytiscidae of Taiwan was published by Nilsson et al. (1995), who reported 58 species. With another seven publications (Hendrich and Balke 1997; Wang et al. 1998; Balke and Hendrich 1998; Wewalka and Wang 2007; Hájek et al. 2018; Liu and Watanabe 2018; Watanabe et al. 2018), the number of species reported from Taiwan increased to 66. During 1990–2004, one of us (L.-J. Wang) frequently collected diving beetles in various aquatic habitats around Taiwan, including on a few small satellite islands. In the

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present paper, we report new records of *Hydrovatus subrotundatus* Motschulsky, 1859 and *Hydrovatus pudicus* (Clark, 1863) from Taiwan and update the information of the habitats of these species. Altogether eight species of the genus *Hydrovatus* are now recorded from Taiwan, raising the number of Taiwanese dytiscid species to 68.

Methods

All specimens were collected using aquatic dip nets with fine mesh. Specimens were preserved in 75% ethanol and later dry-mounted for photography. The specimens of Taiwanese *Hydrovatus* species in this study were examined using a Leica MZ125 microscope. Images of the specimens were taken with Leica DFC490 digital cameras mounted on a Leica Z16 APO. All voucher specimens (No.TFRI-DY-Hvsub001, No.TFRI-DY-Hvsub002, No.TFRI-DY-Hvpud001, No.TFRI-DY-Hvpud002) were deposited in the Laboratory of Forest Insects and Systematic Entomology, Taiwan Forestry Research Institute (TFRI), Taipei, Taiwan.

Results

***Hydrovatus subrotundatus* Motschulsky, 1859**

New records. TAIWAN – Taitung Co. • Orchid Island (Lanyu), Langdao; 22°04′41″N, 121°31′51″E; 10 m alt.; 16.IX.1994; L.-J. Wang leg.; 1 ♂, No.TFRI-DY-Hvsub001, TFRI – Taitung Co. • Orchid Island (Lanyu), Dongqing; 22°00′53″N, 121°35′45″E; 15 m alt.; 25.III.2000; L.-J. Wang leg.; 1 ♂; No.TFRI-DY-Hvsub002, TFRI.

Distribution. India, Bangla Desh, Nepal, Myanmar, Thailand, Laos, Vietnam, China, Philippines Japan, Malaysia, Singapore, Indonesia (Sumatra, Java, Bali) (Biström 1997; Hendrich et al. 2004; Watanabe and Biström 2020), and Taiwan (**first records**) (Fig. 1).

Identification. The species was identified based on the monograph by Biström (1997). We here provide a habitus photograph of the species (Fig. 2A). *Hydrovatus subrotundatus* is characterized by the distinct visible lateral margin between the elytra and epipleura, and the narrow apex of the median lobe of male genitalia (Biström 1997: 140); body length = 2.28–2.88 mm.

***Hydrovatus pudicus* (Clark, 1863)**

New records. TAIWAN – Pingtung Co. • Mudan township, Tungyuan; 22°12′04″N, 120°51′22″E; 315 m alt.; 27.I.1995; L.-J. Wang leg.; 1 ♂, No.TFRI-DY-Hvpud001, TFRI – Pingtung Co. • Mudan township, Tungyuan; 22° 12′09″N, 120°51′17″E; 310 m alt.; 15.III.2014; L.-J. Wang leg.; 1 ♂, No. TFRI-DY-Hvpud002, TFRI.

Distribution. Burma, Thailand, Laos, Malaysia, Singapore, Indonesia (Sumatra, Java, Bali), Philippines (Biström 1997), and Taiwan (**first record**) (Fig. 1).

Identification. The species was identified based on the monograph by Biström (1997). We here provide a habitus photo of the species (Fig. 2B). *Hydrovatus pudicus* is characterized by a more elongate body, a fine elytral punctuation, and a penis that is parallel-sided towards the apex in dorsal view (Biström 1997: 316); body length = 1.78–2.26 mm.

Discussion

We report on the first records of the two widespread species *Hydrovatus subrotundatus* and *Hydrovatus pudicus* in Taiwan. The habitats of both species in Taiwan are standing waters, which is consistent with the characteristics of the strictly lentic genus *Hydrovatus* (Balke and Hendrich 2016). The two species were also collected at light traps (Biström 1997). The habitat of these two species was first reported as collected at the edge of paddy fields, in very shallow water, and among mud, floating roots, and grasses in Bali, Indonesia (Hendrich and Balke 1995). In Thailand, *H. pudicus* has been collected from muddy, shallow, exposed pools formed by water

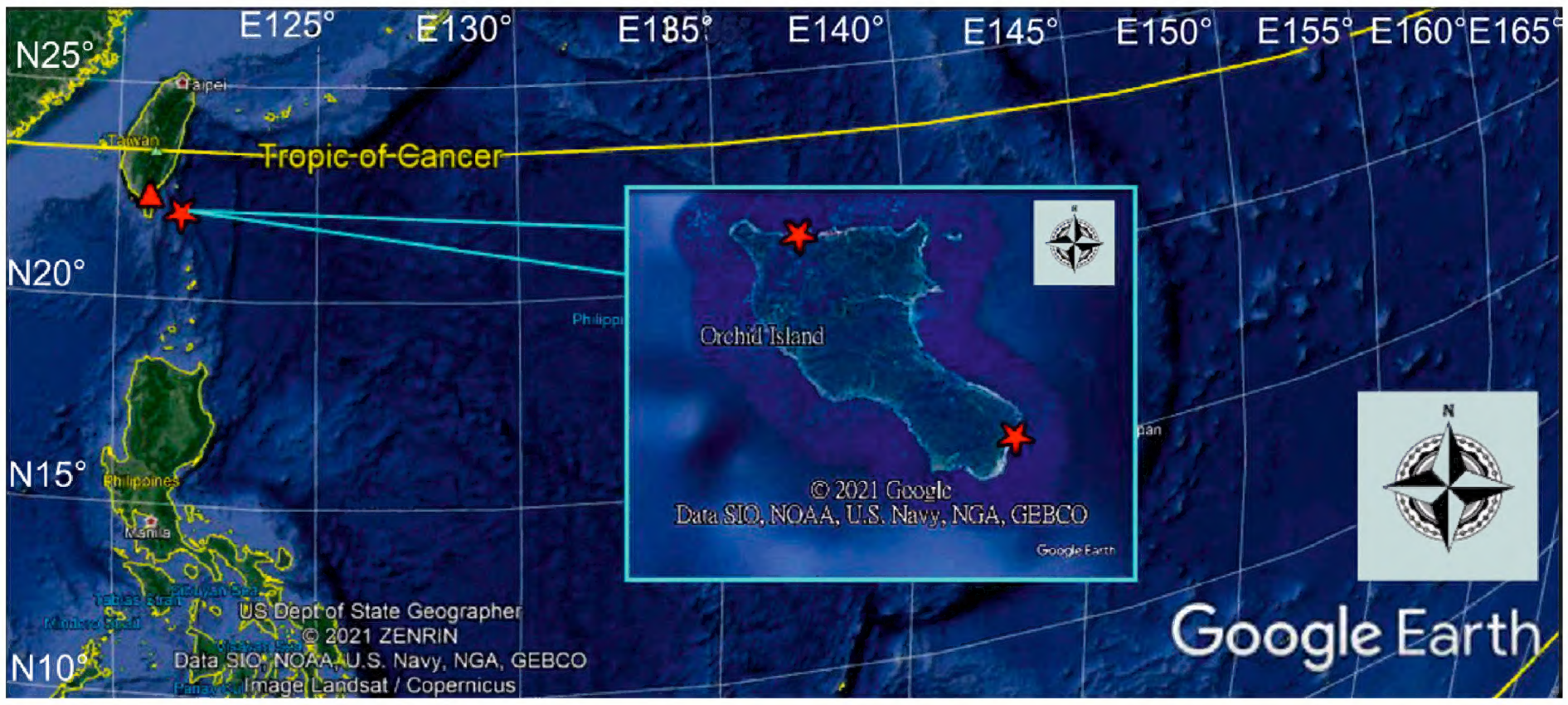

Figure 1. Distribution of *Hydrovatus subrotundatus* (red stars) and *Hydrovatus pudicus* (red triangle) in Taiwan.

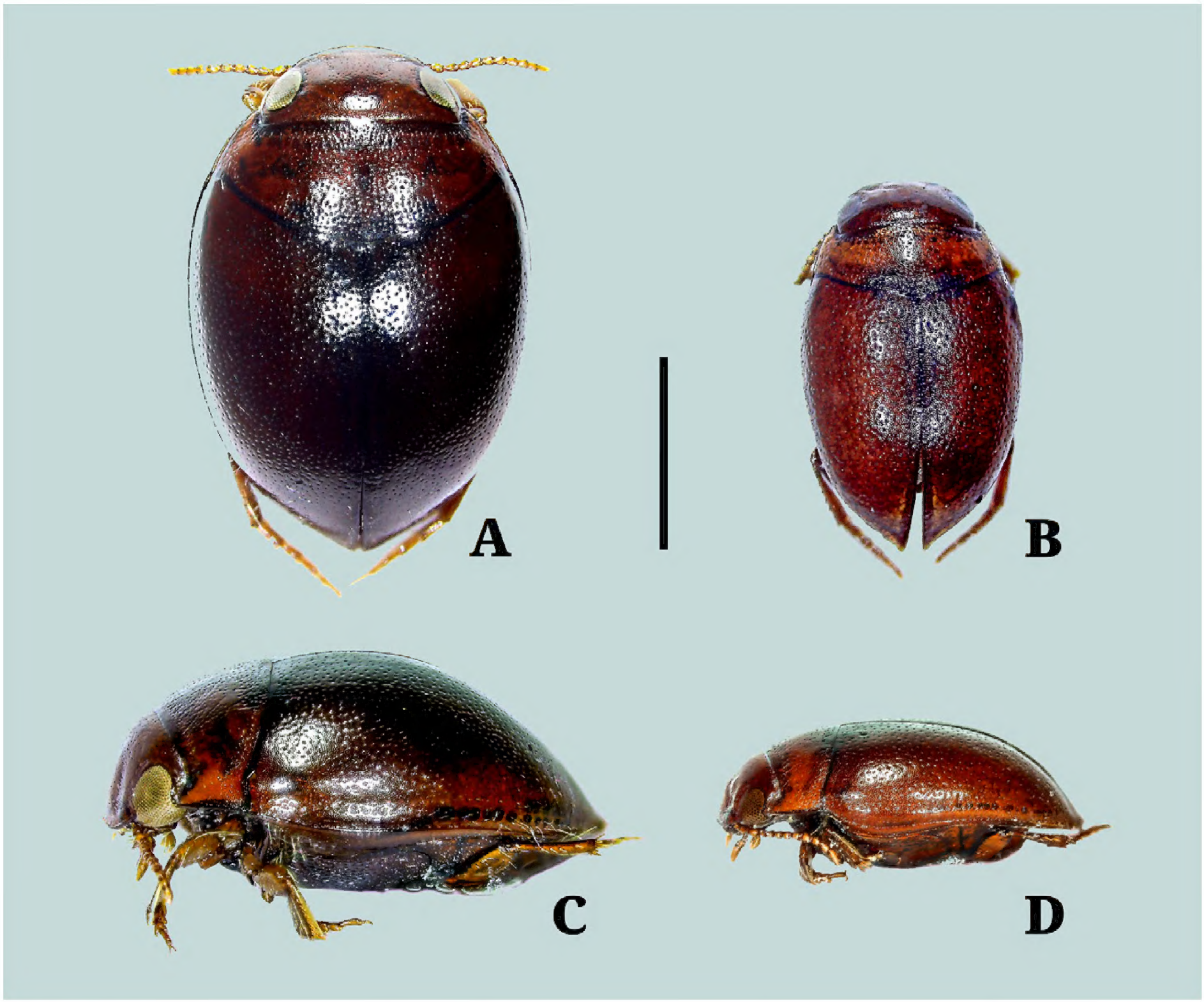

Figure 2. A. Habitus of *H. subrotundatus* from Orchid Island, Taiwan; in dorsal view. **B.** Habitus of *H. pudicus* from Tungyuan Swamp, Taiwan; in dorsal view. **C.** Habitus of *H. subrotundatus*, in lateral view. **D.** Habitus of *Hydrovatus pudicus*, in lateral view. Scale bar = 1 mm.

buffalos on open meadows (Hendrich unpublished data); in Singapore, *H. pudicus* was recorded from shallow, muddy water of open swamps, at the edge of artificial ponds (e.g., garden or ornamental ponds), and in slow flowing drainage ditches (Hendrich et al. 2004).

The habitat of *H. subrotundatus* in Taiwan is a Taro (*Colocasia esculenta* (L.) Schott) field in Orchid Island (Fig. 3). It was collected along the margin of the field full of algae. There were 11 dytiscid species syntopically collected with *H. subrotundatus*, including *Cybister sugillatus* Erichson, 1834, *Hygrotus rufus* (Clark, 1863), *Allodessus megacephalus* (Gschwendtner, 1931), *Hydroglyphus flammulatus* (Sharp, 1882), *Hydroglyphus inconstans* (Régimbart, 1892), *Hydrovatus acuminatus* Motschulsky, 1859, *Hydrovatus subtilis* Sharp, 1882, *Hydaticus vittatus* (Fabricius, 1775), *Hyphydrus pulchellus* Clark, 1863, *Laccophilus sharpi* Régimbart, 1889, and *Pseuduvarus vitticollis* (Boheman, 1848). Taro is a traditional crop for the Tao aboriginal people on Orchid Island. They plant Taro in the field without using pesticides and keep the environment friendly and beneficial for biodiversity, especially for the invertebrates. The

Figure 3. Habitat of *H. subrotundatus* on Orchid Island, Taiwan.

stem of Taro provides the substratum for oviposition in *Cybister sugillatus* and *Hydaticus vittatus* (Wang unpublished field and laboratory data) and probably for *Hydrovatus*, too (Miller and Bergsten 2016).

The habitat of *H. pudicus* is the Tungyung swamp in Taiwan. The swamp is well vegetated with a soft, muddy bottom (Fig. 4). There were 15 dytiscid species syntopically collected with *H. pudicus*, including

Figure 4. Habitat of *H. pudicus*, the Tungyuan Swamp, Taiwan.

Cybister sugillatus, *Hydroglyphus amamiensis* (Satô, 1961), *Hydroglyphus flammulatus*, *Hydroglyphus inconstans*, *Hydrovatus acuminatus*, *Hydrovatus bonvouloiri* Sharp, 1882, *Hydrovatus seminarius* (Motschulsky, 1859), *Hydrovatus subtilis*, *Hydaticus vittatus*, *Hydaticus rhantoides* Sharp, 1882 , *Hyphydrus pulchellus*, *Laccophilus chinensis* Boheman, 1858, *Laccophilus sharpi*, *Leiodytes perforatus* (Sharp, 1882), and *Rhantus suturalis* (Macleay, 1825).

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Authors' Contributions

Investigation: LJW. Methodology: LJW. Visualization: LH, MB. Writing – original draft: LJW, LH. Writing – review and editing: LH, MB.

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